

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

LISTING OF CLAIMS:

Claims 1-21. (cancelled).

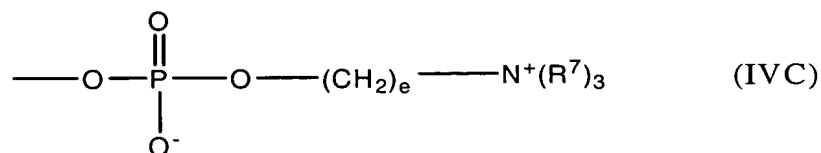
22. (new:) A cross-linked polymer formed by
- a) radical polymerisation of radical polymerisable monomers including
- i) a zwitterionic monomer having the formula:
- $$Y-B-X$$

wherein

B is a straight or branched alkylene, oxaalkylene or oligo-oxaalkylene chain optionally containing one or more fluorine atoms up to and including perfluorinated chains, or if X contains a carbon-carbon chain between B and the centre of permanent position charge or if Y contains a terminal carbon atom bonded to B, a valence bond;

X is a zwitterionic group selected from groups, IVC, IVD and IVF in which

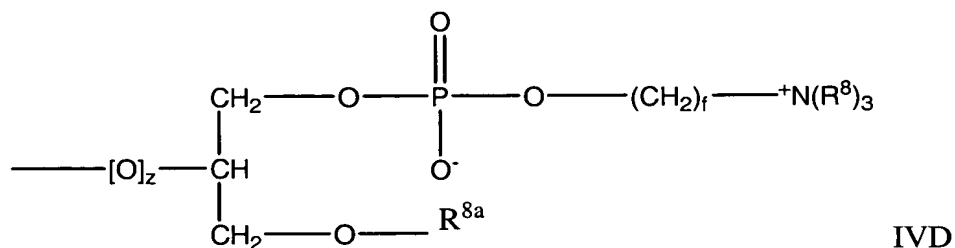
group IVC has the formula



where

the groups R^7 are the same or different and each is hydrogen or C_{1-4} alkyl, and e is from 1 to 4;

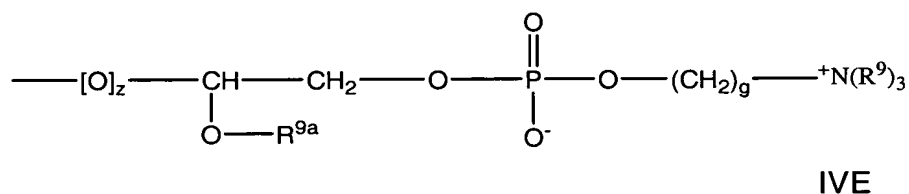
group IVD has the formula



wherein

the groups R^8 are the same or different and each is hydrogen or C_{1-4} alkyl, R^{8a} is hydrogen or a group ---C(O)B^1R^{8b} wherein R^{8b} is hydrogen or methyl, B^1 is a valence bond or straight or branched alkylene, oxaalkylene or olig-oxaalkylene group, and f is from 1 to 4; and if B is other than a valence bond z is 1 and if B is a valence bond z is 0, if X is directly bonded to an oxygen or nitrogen atom and otherwise z is 1;

group IVE has the formula

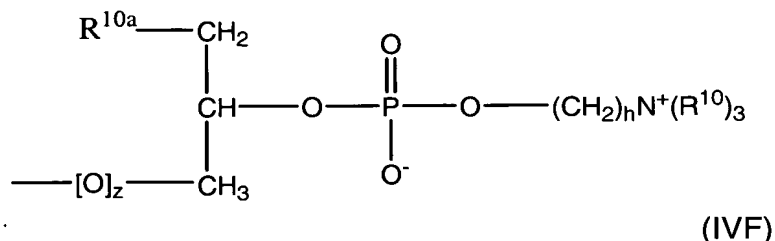


wherein

the groups R^9 are the same or different and each is hydrogen or $C_1\text{--}C_4$ alkyl, R^{9a} is hydrogen or a group, ---C(O)B^2R^{9b} wherein R^{9b} is hydrogen or methyl, B^2 is a valence bond or a straight or branched alkylene, oxaalkylene or olig-oxaalkylene or oligo-oxaalkylene group, and g is from 1 to 4; and

if B is other than a valence bond z is 1 and if B is a valence bond z is 0
 if X is directly bonded to an oxygen or nitrogen atom and otherwise z is 1;
 and

group IVF has the formula

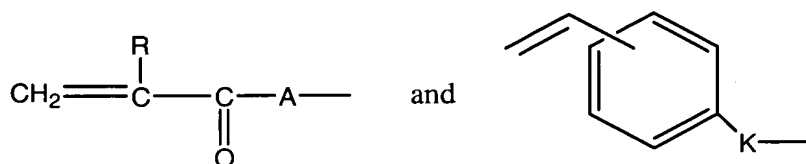


wherein

the groups R^{10} are the same or different and each is hydrogen or C_{1-4} alkyl, R^{10a} is hydrogen or a $-\text{C}(\text{O})\text{B}^3\text{R}^{10b}$ group wherein R^{10b} is hydrogen or methyl, B^3 is a valence bond or a straight or branched alkylene, oxaalkylene or oligo-oxaalkylene group, and h is from 1 to 4; and

if B is other than a valence bond z is 1 and if B is a valence bond z is 0
 if X is directly bonded to the oxygen or nitrogen and otherwise z is 1 and;

Y is an ethylenically unsaturated polymerisable group selected from



wherein:

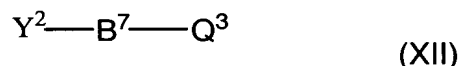
R is hydrogen or a $\text{C}_1\text{-C}_4$ alkyl group;

A is $-\text{O}-$ or $-\text{NR}^1$ where R^1 is hydrogen or a $\text{C}_1\text{-C}_4$ alkyl group or R^1 is $-\text{B-X}$ where B and X are as defined above; and

K^2 is a group $-(\text{CH}_2)_p\text{OC}(\text{O})-$, $-(\text{CH}_2)_p\text{C}(\text{O})\text{O}-$, $-(\text{CH}_2)_p\text{OC}(\text{O})\text{O}-$, $-(\text{CH}_2)_p\text{NR}^2-$, $-(\text{CH}_2)_p\text{NR}^2\text{C}(\text{O})-$, $-(\text{CH}_2)_p\text{C}(\text{O})\text{NR}^2-$, $-(\text{CH}_2)_p\text{NR}^2\text{C}(\text{O})-$, $-(\text{CH}_2)_p\text{OC}(\text{O})\text{NR}^2-$, $-(\text{CH}_2)_p\text{NR}^2\text{C}(\text{O})\text{NR}^2-$, (in which the groups R^2 are the same or different)

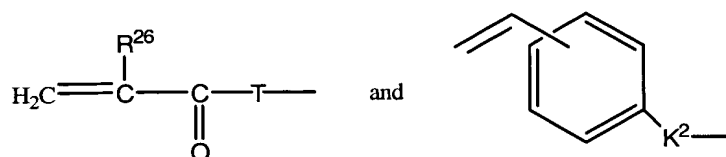
$-(\text{CH}_2)_p\text{O}$, $-(\text{CH}_2)_p\text{SO}_3^-$, or, optionally in combination with B , a valence bond and p is from 1 to 12 and R^2 is hydrogen or a $\text{C}_1\text{-C}_4$ alkyl group and

- ii) a monomer having a reactive group of the formula general formula (XII)



where

Y^2 is an ethylenically unsaturated polymerisable group selected from



where

R^{26} is hydrogen or C_1 - C_4 alkyl;

T is -O- or NR^{27} or , wherein R^{27} is hydrogen or a C_1 - C_4 alkyl group or R^{27} is a $-B^7Q_3$ group ;

B^7 is a valence bond a straight or branched alkylene oxaalkylene or oligo-oxaalkylene group;

K^2 is a group $-(CH_2)_qOC(O)-$, $-(CH_2)_qC(O)O-$, $-(CH_2)_qOC(O)O-$, $-(CH_2)_qNR^{20}-$, $-(CH_2)_qNR^{20}C(O)O-$, $-(CH_2)_qC(O)NR^{20}-$, $-(CH_2)_qNR^{20}C(O)O-$, $-(CH_2)_qOC(O)NR^{20}-$, $-(CH_2)_qNR^{20}C(O)NR^{20}-$ (in which the groups R^{20} are the same or different), $-(CH_2)_qO-$ or $-(CH_2)_qSO_3-$ or , or a valence bond and q is from 1 to 12 and R^{20} is hydrogen or C_1 - C_4 alkyl group; and

Q^3 is a reactive group selected from the groups consisting of aldehyde groups; silane and siloxane groups containing one or more substituents selected from halogen atoms and C_{1-4} -alkoxy groups; hydroxyl; amino; carboxyl; epoxy; $-CHOHCH_2Hal$ (in which Hal is selected from chlorine, bromine and iodine atoms); succinimido; tosylate; triflate; imidazole carbonylamino; optionally substituted triazine groups; cinnamyl; ethylenically and acetylenically unsaturated groups; acetoacetoxy; methylol; and chloroalkylsulphone groups; and

b) cross-linking the polymer by forming cross-linkages between groups Q^3 derived from the said monomer having a reactive group.

23. (new): A polymer according to claim 22 in which Q^3 is selected from the group consisting of aldehyde, silane and siloxane groups containing one or more substituents selected from halogen atoms and C_{1-4} alkoxy groups, amino, epoxy, $CHOHCH_2Hal$ (in which Hal is halogen), succinimido, tosylate, triflate, imidazolecarbonyl amino and optionally substituted triazine groups.

24. (new): A polymer according to claim 22 in which the group Q^3 is selected from the group consisting of amino, acetylenically unsaturated hydrocarbon groups, 3-chloro-2-hydroxypropyl and 3-trimethoxy silyl propyl.

25. (new): A polymer according to claim 22 in which the said monomer having a reactive group is selected from the group consisting of 2-aminoethylmethacrylate, 7-dodecynmethacrylate, 3-chloro-2-hydroxypropylmethacrylate and 3-(trimethoxysilyl) propylmethacrylate.

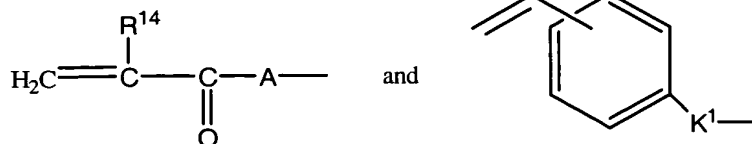
26. (new): A polymer according to claim 22 in which said radical polymerisable monomers include a comonomer having the general formula (VI)



(VI)

where

Y^1 is an ethylenically unsaturated polymerisable group selected from



where

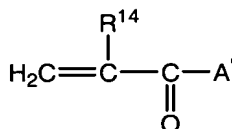
R^{14} is hydrogen or C_1-C_4 alkyl,

A' is -O- or -NR¹⁵- where R¹⁵ is hydrogen or a C₁-C₄ alkyl group or R¹⁵ is a group Q;

K¹ is a group - (CH₂)_lOC(O)-, -(CH₂)_lC(O)O-, -(CH₂)_lOC(O)O-, - (CH₂)_lNR¹⁶-, -(CH₂)_lNR¹⁶C(O)-, -(CH₂)_lC(O)NR¹⁶-, -(CH₂)_lNR¹⁶CH(O)O-, - (CH₂)_lOC(O)NR¹⁶-, -(CH₂)_lNR¹⁶C(O)NR¹⁶- (in which the groups R¹⁶ are the same or different), -(CH₂)_lO-, -(CH₂)_lSO₃, a valence bond and l is from 1 to 12 and R¹⁶ is hydrogen or a C₁-C₄ alkyl group; and

Q is selected from the group consisting of straight and branched alkyl, alkoxyalkyl and (oligo-alkoxy)alkyl groups containing 6 to 24 carbon atom, any of which groups is unsubstituted or substituted by one or more fluorine atoms and optionally contains one or more carbon-carbon double or triple bonds; and siloxane groups (CR^{16a}₂)_{qq}(SiR^{16b}₂)(OSiR^{16b}₂)_{pp}R^{16b} in which each group R^{16a} is the same or different and is selected from the group consisting of hydrogen, alkyl groups of 1 to 4 carbon atoms and aralkyl groups, each group R^{16b} is alkyl of 1 to 4 carbon atoms, qq is from 1 to 6 and pp is from 0 to 49.

27. (new): A polymer according to claim 26 in which Y¹ is



in which

R¹⁴ is methyl;

A' is -O-; and

Q is an alkyl group of the formula -(CR¹⁷₂)_mCR¹⁷ wherein the groups -(CR¹⁷₂)_m are the same or different and in each group -(CR¹⁷₂)_m the groups R¹⁷ are the same or different and each group R¹⁷ is selected from the group consisting of hydrogen, C₁₋₄ -alkyl and -fluoroalkyl and fluorine and m is in the range 5 to 23.

28. (new): A polymer according to claim 27 in which the said comonomer is selected from the group consisting of n-dodecyl methacrylate, octadecyl methacrylate, hexadecylmethacrylate, 1H, 1H, 2H, 2H-heptadecafluorodecylmethacrylate, p-octyl styrene, p-dodecyl styrene and monomethacryloyloxypropyl terminated siloxanes.

29. (new): A polymer according to claim 28 in which the said comonomer is dodecyl methacrylate.

30. (new): A polymer according to claim 22 in which the said radical polymerisable monomers include a diluent monomer selected from the group consisting of C₁₋₄ -alkyl(alk)acrylates, N, N-dialkylamino alkyl(alk)acrylates containing 1 to 4 carbon atoms in each N-alkyl group and 1 to 4 carbon atoms in the alkylene group, C₁₋₄ alkyl(alk)acrylamide, hydroxy C₁₋₄ -alkyl(alk)acrylate, N-vinyl lactam having 5-7 atoms in the lactam ring, styrene, derivatives of styrene having ring substituents selected from C₁₋₄ alkyl groups and halogen atoms, polyhydroxyl (alk)acrylates, alkenes, butadiene, maleic anhydride and acrylonitrile.

31. (new): A polymer according to claim 30 in which the diluent monomer is selected from hydroxy C₁₋₄ -alkyl(alk)acrylates and polyhydroxyl(alk)acrylates.

32. (new): A polymer according to claim 22 in which the said radical polymerisable monomers include at least 5% by weight zwitterionic monomer and at least 0.1% by weight monomer having a reactive group.

33. (new): A polymer according to claim 22 in which the said radical polymerisable monomers include at least 5% by weight zwitterionic monomer and 0.1% to 20% by weight monomer having a reactive group.

34. (new): A polymer according to claim 30 in which the said radical zwitterionic monomers include at least 5% by weight, at least 0.1% by weight monomer having a reactive group and 5 to 20% by weight diluent monomer.

35. (new): A polymer according to claim 26 in which the said radical polymerisable monomers include at least 5% by weight zwitterionic monomer, at least 0.1% by weight monomer having a reactive group and 5 to 90% by weight of said comonomer.

36. (new): A polymer according to claim 22 in which said cross-linkage is by direct reaction of groups Q^3 with one another.

37. (new): A polymer according to claim 22 in which said cross-linkage is by reaction of groups Q^3 with a reactive bridging molecule.

38. (new): A process in which a cross-linkable polymer is cross-linked by forming cross-linkages between reactive groups Q^5 on the polymer wherein the cross-linkable polymer is formed by

a) radical polymerisation of radical polymerisable monomers including

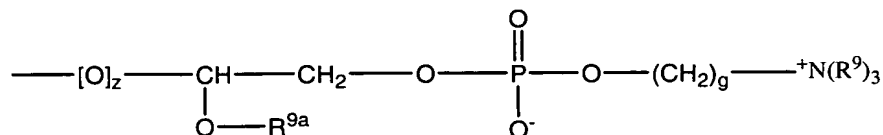
i) a zwitterionic monomer having the formula:



wherein

the groups R^8 are the same or different and each is hydrogen or C_{1-4} alkyl, R^{8a} is hydrogen or a $-C(O)B^1R^{8b}$ group wherein R^{8b} is hydrogen or methyl, B^1 is a valence bond or straight or branched alkylene, oxaalkylene or olig-oxaalkylene group, and f is from 1 to 4; and if B is other than a valence bond z is 1 and if b is a valence bond z is 0, if X is directly bonded to an oxygen or nitrogen atom and otherwise z is 1;

group IVE has the formula



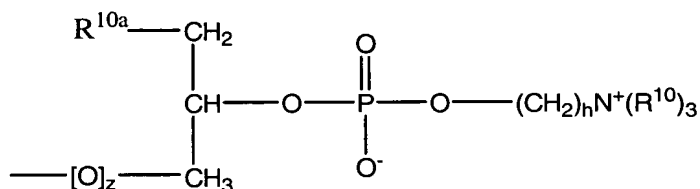
IVE

wherein

the groups R^9 are the same or different and each is hydrogen or C_1 - C_4 alkyl, R^{9a} is hydrogen or a $-C(O)B^2R^{9b}$ group, wherein R^{9b} is hydrogen or methyl, B^2 is a valence bond or a straight or branched alkylene, oxaalkylene or oligo-oxaalkylene or oligo-oxaalkylene group, and g is from 1 to 4; and

if B is other than a valence bond z is 1 and if B is a valence bond z is 0
 if X is directly bonded to an oxygen or nitrogen atom and otherwise z is 1;
 and

group IVF has the formula



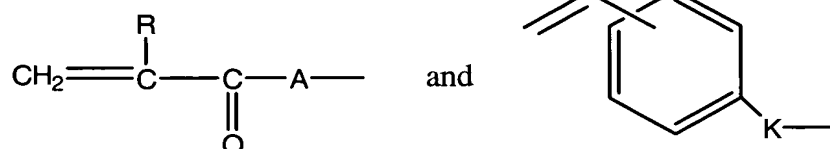
(IVF)

wherein

the groups R^{10} are the same or different and each is hydrogen or C_{1-4} alkyl, R^{10a} is hydrogen or a $-C(O)B^3R^{10b}$ group wherein R^{10b} is hydrogen or methyl, B^3 is a valence bond or a straight or branched alkylene, oxaalkylene or oligo-oxaalkylene group, and h is from 1 to 4; and

if B is other than a valence bond z is 1 and if B is a valence bond z is 0
 if X is directly bonded to the oxygen or nitrogen and otherwise z is 1 and;

Y is an ethylenically unsaturated polymerisable group selected from



wherein:

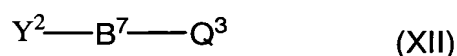
R is hydrogen or a C₁-C₄ alkyl group;

A is -O- or -NR¹ where R¹ is hydrogen or a C₁-C₄ alkyl group or R¹ is -B-X where B and X are as defined above; and

K² is a group - (CH₂)_pOC(O)-, -(CH₂)_pC(O)O-, -(CH₂)_pOC(O)O-, - (CH₂)_pNR²-, -(CH₂)_pNR²C(O)-, -(CH₂)_pC(O)NR²-, -(CH₂)_pNR²C(O)-, - (CH₂)_pOC(O)NR²-, -(CH₂)_pNR²C(O)NR²-, (in which the groups R² are the same or different)

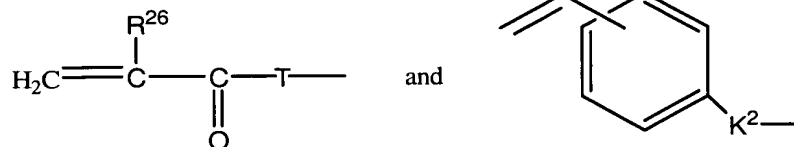
-(CH₂)_pO-, -(CH₂)_pSO₃⁻, or, optionally in combination with B, a valence bond and p is from 1 to 12 and R² is hydrogen or a C₁-C₄ alkyl group and

ii) a monomer having a reactive group of the formula general formula (XII)



where

Y² is an ethylenically unsaturated polymerisable group selected from



where

R²⁶ is hydrogen or C₁-C₄ alkyl;

T is -O- or NR²⁷ or , wherein R²⁷ is hydrogen or a C₁-C₄ alkyl group or

R²⁷ is a —B⁷Q₃ group ;

B⁷ is a valence bond a straight or branched alkylene oxaalkylene or oligo-oxaalkylene group;

K² is a group - (CH₂)_qOC(O)-, -(CH₂)_qC(O)O-, -(CH₂)_qOC(O)O-, - (CH₂)_qNR²⁰-, -(CH₂)_qNR²⁰C(O)O-, -(CH₂)_qC(O)NR²⁰-, -(CH₂)_qNR²⁰C(O)O-, - (CH₂)_qOC(O)NR²⁰-, -(CH₂)_qNR²⁰C(O)NR²⁰- (in which the groups R²⁰ are the same or different), -(CH₂)_qO- or -(CH₂)_qSO₃- or , or a valence bond and q is from 1 to 12 and R²⁰ is hydrogen or C₁-C₄ alkyl group; and

Q³ is a reactive group selected from the groups consisting of aldehyde groups; silane and siloxane groups containing one or more substituents selected from halogen atoms and C₁₋₄ -alkoxy groups; hydroxyl; amino; carboxyl; epoxy; -CHOHCH₂Hal (in which Hal is selected from chlorine, bromine and iodine atoms); succinimido; tosylate; triflate; imidazole carbonylamino; optionally substituted triazine groups; cinnamyl; ethylenically and acetylenically unsaturated groups; acetoacetoxy; methylol; and chloroalkylsulphone groups.

39. (new): A process according to claim 38 in which Q³ is selected from the group consisting of aldehyde, silane and siloxane groups containing one or more substituents selected from halogen atoms and C₁₋₄ alkoxy groups, amino, epoxy, CHOHCH₂Hal (in which Hal is halogen), succinimido, tosylate, triflate, imidazolecarbonyl amino and optionally substituted triazine groups.

40. (new): A process according to claim 38 in which the group Q³ is selected from the group consisting of amino, acetylenically unsaturated hydrocarbon groups, 3-chloro-2-hydroxypropyl and 3-trimethoxy silyl propyl.

41. (new): A process according to claim 38 in which the said monomer having a reactive group is selected from the group consisting of 2-aminoethylmethacrylate, 7-dodecynmethacrylate, 3-chloro-2-hydroxypropylmethacrylate and 3-(trimethoxysilyl) propylmethacrylate.

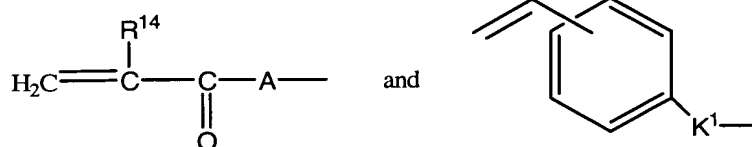
42. (new): A process according claim 38 in which said radical polymerisable monomers include a comonomer having the general formula (VI).

Y¹-Q

(VI)

where

Y¹ is an ethylenically unsaturated polymerisable group selected from



where

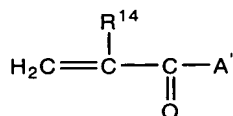
R¹⁴ is hydrogen or C₁-C₄ alkyl,

A' is -O- or -NR¹⁵- where R¹⁵ is hydrogen or a C₁-C₄ alkyl group or R¹⁵ is a group Q;

K¹ is a group - (CH₂)_lOC(O)-, -(CH₂)_lC(O)O-, -(CH₂)_lOC(O)O-, - (CH₂)_lNR¹⁶-, -(CH₂)_lNR¹⁶C(O)-, -(CH₂)_lC(O)NR¹⁶-, -(CH₂)_lNR¹⁶CH(O)O-, - (CH₂)_lOC(O)NR¹⁶-, -(CH₂)_lNR¹⁶C(O)NR¹⁶- (in which the groups R¹⁶ are the same or different), -(CH₂)_lO-, -(CH₂)_lSO₃, a valence bond and l is from 1 to 12 and R¹⁶ is hydrogen or a C₁-C₄ alkyl group; and

Q is selected from the group consisting of straight and branched alkyl, alkoxyalkyl and (oligo-alkoxy)alkyl groups containing 6 to 24 carbon atom, any of which groups is unsubstituted or substituted by one or more fluorine atoms and optionally contains one or more carbon-carbon double or triple bonds; and siloxane groups (CR^{16a}₂)_{qq}(SiR^{16b}₂)(OSiR^{16b}₂)_{pp}R^{16b} in which each group R^{16a} is the same or different and is selected from the group consisting of hydrogen, alkyl groups of 1 to 4 carbon atoms and aralkyl groups, each group R^{16b} is alkyl of 1 to 4 carbon atoms, qq is from 1 to 6 and pp is from 0 to 49.

43. (new): A process according claim 38 in which Y¹ is



in which

R¹⁴ is methyl;

A' is -O-; and

Q is an alkyl group of the formula $-(\text{CR}^{17}_2)_m\text{CR}^{17}$ wherein the groups $-(\text{CR}^{17})_2-$ are the same or different and in each group $-(\text{CR}^{17}_2)-$ the groups R¹⁷ are the same or different and each group R¹⁷ is selected from the group consisting of hydrogen, C₁₋₄ -alkyl and -fluoroalkyl and fluorine and m is in the range 5 to 23.

44. (new): A process according to claim 43 in which the said comonomer is selected from the group consisting of n-dodecyl methacrylate, octadecyl methacrylate, hexadecylmethacrylate, 1H, 1H, 2H, 2H-heptadecafluorodecylmethacrylate, p-octyl styrene, p-dodecyl styrene and monomethacryloyloxypropyl terminated siloxanes.

45. (new): A process according to claim 44 in which the said comonomer is dodecyl methacrylate.

46. (new): A process according to claim 38 in which the said radical polymerisable monomers include a diluent monomer selected from the group consisting of C₁₋₄ -alkyl(alk)acrylates, N, N-dialkylamino alkyl(alk)acrylates containing 1 to 4 carbon atoms in each N-alkyl group and 1 to 4 carbon atoms in the alkylene group, C₁₋₄ alkyl(alk)acrylamide, hydroxy C₁₋₄ -alkyl(alk)acrylate, N-vinyl lactam having 5-7 atoms in the lactam ring, styrene, derivatives of styrene having ring substituents selected from C₁₋₄ alkyl groups and halogen atoms, polyhydroxyl (alk)acrylates, alkenes, butadiene, maleic anhydride and acrylonitrile.

47. (new): A process according to claim 46 in which the diluent monomer is selected from hydroxy C₁₋₄ -alkyl(alk)acrylates and polyhydroxyl(alk)acrylates.

48. (new): A process according to claim 38 in which the said radical polymerisable monomers include at least 5% by weight zwitterionic monomer and at least 0.1% by weight monomer having a reactive group.

49. (new): A process according to claim 38 in which the said radical polymerisable monomers include at least 5% by weight zwitterionic monomer and 0.1% to 20% by weight monomer having a reactive group.

50. (new): A polymer according to claim 46 in which the said radical zwitterionic monomers include at least 5% by weight, at least 0.1% by weight monomer having a reactive group and 5 to 20% by weight diluent monomer

51. (new): A process according to claim 42 in which the said radical polymerisable monomers include at least 5% by weight zwitterionic monomer, at least 0.1% by weight monomer having a reactive group and 5 to 90% by weight of said comonomer.

52. (new): A process according to claim 38 in which said cross-linkage is by direct reaction of groups Q³ with one another.

53. (new): A process according to claim 38 in which said cross-linkage is by reaction of groups Q³ with a reactive bridging molecule.

54. (new): A polymer according to claim 22 in which X is said group IVC.

55. (new): A process according to claim 38 in which X is said group IVC.